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S Y L L A B U S

COURSE OF LECTURES

NATURAL AND EXPERIMENTAL PHILOSOPHY,

By A. WALKER,

Lecturer to his Royal Highness the Duke of Gloucester, to Eton and Winchester Colleges, and Members of the Dublin Society.

THIS extensive Course consists of the most curious, useful, new, and entertaining parts of Philosophy; it is an Epitome of the whole oeconomy of the universe, as well as the more familiar parts of nature, and very agreeably sets before the inquisitive mind the most useful productions of the human Art and Enquiry: and as the terms are explained, and no stile affected but that of simplicity and plainness, it is humbly presumed that the course is interesting to, and may be comprehended by all ranks and stations in life; and is particularly adapted to such Gentlemen and Ladies as would chuse to be acquainted with the more rational and sublime parts of knowledge in the most easy manner, and at the least expence. The Course consists of twelve Lectures; and the apparatus is the whole of a justly admired set of instruments collected by a late celebrated lecturer, besides a great variety added to them by the present Proprietor; and before this Addition, they were esteemed by the Professors in both Universities, the most complete, extensive, and valuable collection in Great Britain.

To enumerate the whole of this apparatus would far exceed the bounds of a syllabus—but a few of its particulars are these, viz. The grand orrery, much improved. A transparent orrery, more like nature than any thing of the kind; variety of new constructed globes, spheres, planetariums, cometariums, &c. The whirling tables on the newest construction. Air-pumps. Magazine and walking-cane wind guns. Condensers, &c. Reflecting, refracting, and patent telescopes. All kinds of mirrors and deceptions. Lenses, &c. The artificial eye and ear, lungs, thorax, and diaphragma. Solar and double microscopes of the latest improvement. Camera obscuræ. Diagonal mirrors. Opera glasses. Magic lanthorns, &c. Dr. Hally's improved diver's bell. All kinds of syphons, fountains, and spouting pipes. The hydrostatic paradox, and variety of new methods of proving the upward, downward, and lateral pressure of water. Tide-tables and other machines, invented by Mr. Ferguson. The pyrometer. The electrical machine greatly improved—the electrical battery, thunder-house, electropher, guns, &c. Loadstones, and all kinds of magnets. All the mechanical powers, with working models of various cranes, pumps, water-mills, pile-drivers, engines, plows, carts, coaches, ships, the centrifugal machine, and a working fire-engine, for draining mines, of the latest constructions. Also another working fire-engine, which, by means of an inverted piston, will do the same work at about two thirds the expence. Also another working model for the same purpose, which saves the expence

of fire, by forming the vacuum with cold water and cold air; *Blakeley* and *Watts's* patent engines. Likewise a new contrived bucket-engine, which works with a remarkable small quantity of water; and a windmill, which, by cloathing and uncloathing itself, moves with the same velocity in high or low winds. Working models also of ventilators, on a new construction. And also a Machine that will raise water to any height to supply gentlemen's houses, towns or villages, without the assistance of wind, fire, water-wheel, man, or beast, &c. Each of the twelve Lectures requires about two hours attendance, and begin in the country so soon as forty have subscribed one guinea each, to be paid at the first lecture, when the days and hours of attendance for the future lectures will be fixed agreeable to the majority of the subscribers. In Town, the Lectures are every *Monday, Wednesday, and Friday*, at twelve, at Mr. *WALKER's* house, *George-street, Hanover-square.*

HEADS of each LECTURE.

LECTURE I. *On the general Properties of Matter.*

1. **E**Xordium, explaining the uses of Philosophical enquiries in arts, trade, agriculture, the knowledge of the Deity, and ourselves.
2. The simple elements, what.—Matter infinitely divisible.—Impenetrably hard.—Inert. All proved by many new and curious experiments.
3. Attraction of cohesion—Repulsion—Solidity and fluidity, what.—How matter, differing in its mode of cohesion, gives that infinite variety of properties in the animal, vegetable, and mineral worlds.—How vegetation, secretion, digestion, and absorption are performed.
4. Original particles of matter of the same weight, proved by the guinea and feather falling in vacuo.
5. Elective attractions defined by affinities, solutions, precipitations, &c.
6. Magnetism. Its history, properties, mode of communication, and deprivation; explained by new and uncommon experiments. How and when applied to navigation.—The needle's variation, with *Dr. Halley's* opinion of its cause.—Best methods of making artificial magnets, and preserving their attraction.
7. Definition of fire, its properties and effects in an active and latent state; what are good and bad conductors of it. Hence the reason of cold produced by mixtures, evaporation, &c. and that heat expands and cold contracts every kind of body. Boiling by the heat of the hand; the pyrometer, eolipile, thermometer, pulse-glass, and still, assist in the above definitions.



LECTURE II. *Mechanics.*

1. **T**HE *Laws of Gravitation*, explained by the figure of the earth—the attraction of mountains—the descent of falling-bodies—planetary motion, &c.
2. *Centre of Gravity*—defining why leaning bodies do not fall—why
bodies

bodies may be suspended on a point—and why others may appear to roll upwards.

3. *Laws of Motion*—shewing how two contrary motions produce a third.—How swimming, flying, shooting is performed.—How curves and projectiles are generated; and how these laws keep the planets in their orbits.

4. The momentum of a stroke, or falling body explained, and calculated.—Percussion and Resistance, what.

5. How, what we gain in power is lost in the time of working any machine; and how its momentum or moving force is calculated.

6. The lever, wheel and axle, pulley, inclined plane, wedge and screw, explained by various models and experiments, and their united power defined by a machine composed of them all.

7. Friction, of both kinds, what.—Surfaces and pressure, how they add to, or diminish, friction.—Friction-wheels, friction-balls, or rollers, how applied to mills, engines, wheel-carriages, moving the large stone to Petersburg, &c. and how much rubbing, or friction takes from the power of all machines whatsoever.

8. An explanation, by working models, of the common pile-driver.—*Voulon's* pile-driver for *Westminster* and *Blackfriars* bridges. A saw-mill.—A wind-mill with an equable motion, and that turns itself to the wind.—The universal joint.—Mr. *Craik's* drill-plough, that saves one third of the seed, rolls the ground, and harrows it at the same time.—A turnip drill-plough.—A ventilator of a new construction, that takes out corrupt air from hospitals, ships, sick-rooms, or cellars, and pours in a current of fresh air.—Machine for clearing the bottom of Rivers.—Carts, waggons, coaches, &c. the advantages and disadvantages of their present construction.—Broad and narrow wheels, friction-wheels, high and low wheels, dished wheels, spring-spoke wheels, teams, and single horse carts, considered.—How best to apply animal strength.—Shoeing and yoking horses, &c.

N. B. *As these Models take up too much time, their explanation will be made to any Subscriber who desires it, after the Lecture.*

LECTURE III. *Principles of Chemistry.*

1. *Solutions*, explained by water and salts—by copper and nitrous acid—by iron and the vitriolic acid—by tartar and vitriol—and spirits of wine and camphor.

2. *Distillation*, by sea water converted into fresh—by wine turned into brandy, &c.

3. *Sublimation*, or *dry distillation*, by the rise of sulphur, benzoin, phosphorus, &c.

4. *Precipitation*, of copper by iron, of silver by copper, of iron by fixt alkali, &c.

5. *Crystallization*, of gum benzoin—Salt of iron—Ammonical salts—Camphor, &c.

6. *Saturation*, explained by Ether in warm water—by salts maintaining their chrySTALLINE form in water, &c.

7. *Affinities*, explained by the production of various colours from colourless

colourless liquors—by sympathetic inks—by acid and alkaline waters with vegetable syrups—by the colouring particles in flowers—by transferring phlogiston from copper to a calcs—by pyrophorus and air—by phosphorus in various experiments—by reviving a calcs—by the iron pyrites producing the hot Bath waters—by vegetable phlogiston—by inflamed zinc—by making red glafs—and the fiery dragon produced by the acids and inflammable oil.

LECTURE IV. *Pneumatics.*

1. **THAT** the air is a body, proved by a new-constructed diver's bell, with air-vessels, &c. and by birds and quadrupeds let down into water without hurt.

2. That the air gravitates, or has weight, proved by its forcing the hand down, and fastening it to the top of a receiver.—By its being weighed in a balance:—By its forcing water into an exhausted bolthead:—By a fountain in vacuo:—By its forcing quicksilver through the pores of wood:—By its bursting bottles, bladders, &c.—By the *Toricellian* experiment:—And by the exhausted hemispheres.—In the course of these experiments it will appear how air and water *dissolve* or *imbibe* one another—how vapours rise into, and fall from, the air—the reason of the rise and fall of the quicksilver in the barometer or weather-glass; and why it foretells rainy or fair weather.

3. That there is no such principle in nature as Suction, proved by a vessel being fastened to the pump-plate without being near the place from whence the sucking quality (if any) must proceed:—By water-pumps not acting in vacuo:—By transferring air from one vessel to another, at a distance from the air-pump:—By the cupping-glass, and by the artificial mouth of a sucking child.

4. That the air has a spring, or an elastic quality, and can occupy a greater space than what it naturally possesses—proved by an inch of air swelling to a prodigious size:—By the swelling of air in a withered apple, making it appear plump and fresh:—By the air in an egg, forcing out the rest of its contents:—By taking air visibly out of gold:—By its lifting great weights:—Making a fountain, forcing quicksilver, &c. shewing this spring equal to its pressure or weight.

5. Boiling defined, by making the ebullition of boiling with the smallest quantity of fire.

6. Definition and reason of winds:—irregular periodical, or partial, viz. trade winds, monsoons, day and night breezes, ternadoes, drafts, buzzings, &c.

LECTURE V. *Pneumatics.*

1. **THAT** the air is capable of being compressed, proved by forcing air upon a blown bladder and shrivelling it up:—By many curious fountains, and by the magazine and walking-cane air guns.

2. That the air is a vehicle of sound, proved by firing gun-powder and a clock strike in vacuo.—Hence the theory of sound, echo, musical chords, musical instruments, &c.

3. Description and dissection of the human ear, and of artificial ears, for the cure of deafness; a new idea.

4. That

4. That the air is filled with an heterogeneous assemblage of the small particles of all kinds of bodies, and that it attracts and precipitates like all other chemical menstrooms—proved by artificial inflammable and suffocating damp—by the seeds and farina of plants being carried abroad in it—by infections and epidemical distempers—and by its dissolution of the phlogistic matter in the lungs. Hence are pointed out the disorders occasioned by breathing corrupt and saturated air, and the evils arising from sitting in low, small, or close rooms, (proved on live animals.)

5. That the air lies in a fixed or latent state in, is a constituent part of, and may be drawn from all animal, vegetable, and mineral substances, proved by Dr. *Priestley's* new and curious experiments on the airs produced by effervescence, fermentation, putrid substances, breath of animals, smoking metals, &c.—How putrid, mephetic, or poisonous airs are produced, affect animals, and are cured. How these airs, thrown up into the atmosphere, are cured by the vegetable kingdom.—How vegetables produce dephlogisticated air; and how nature's self-physic by that means keeps the common air fit for breathing.—The antiseptic qualities of fixt air, proved nitrous air, acid air, alkaline air, fluor acid air, &c.—An atmospheric air also produced, in which animals can live five times as long as in the same quantity of common air, &c. *N. B.* Mr. *W's* new method of ventilating churches, theatres, rooms, &c. will be explained on a curious model of an house, whose rooms are all warmed with one fire; and which can have their air changed for warm, cold, or filtered air, without trouble.

6. A Baloon or tangible body produced, that will rise in air, as cork in water. Bullets discharged by inflammable air, as forcibly as with gunpowder; and a vacuum made without an air-pump, by a means entirely new.

7. How animals are affected in vacuo—proved by artificial lungs, and a live animal put in a receiver, if desired.

LECTURE VI. *Hydrostatics.*

1. **HOW** far water is compressible—proved by the *Florentine* and Mr. *Canton's* experiments—the pulse-glass, &c.

2. That it presses in all directions alike, according to its perpendicular height—proved by pillars of particles—specific gravities—models of smoking chimneys, and their cure—by hydrometers—by lead made to swim, and cork to sink—by a new experiment to shew how much its pressure is against banks, flood-gates, sides of perpendicular pipes, tops of drains, &c.—by the hydrostatic paradox—by swimming—by *Faux's* figures—by the bed made in water by a ship—and by fountains.

3. What solids heavier than water lose by being immersed in it, proved by weighing lead, brass, gold, &c. in air and water—by the alloy found in king *Hiero's* crown, and in *English* and foreign coins.

4. The nature and use of cranes and syphons—explained by decanting fluids out of bung-holes, wells, &c. *Tantalus's* cup, intermitting springs, &c. Hence the doctrine of fountains, brooks, rivers, &c.

5. The

5. The doctrine of spouting fluids—proved by their effects on water, wheels in lifting weights, &c. by the most approved methods of applying water to wheels—best angle for horizontal spouting—and by the ratio of tapping an head of water.

6. Working models of *Archimedes's* screw-pump.—Household or sucking-pump.—Force pump, and extinguishing engine.—Lifting pump—(best way of applying manual strength to them.)—Square pump, with a pyramidal piston (peculiarly adapted to draining.)—Centrifugal pump, that forms the vacuum by a whirling motion.—Pump that works by the motion of a ship.—A rope pump.—Bucket engine to supply houses or towns with water.—Another for draining mines, of vast power and simplicity.—Dr. *Barker's* cylindrical mill, that gives motion to the stones without wheels, cogs, or rungs.—*Blakeley, Boulton, and Watts's* patent fire or steam engines.—A common fire engine, with an inverted piston; and one on an entirely new construction.

LECTURE VII. *Electricity.*

1. History and present state of discoveries in Electricity.

2. Electric and non-electric substances exhibited by various experiments on conducting and non-conducting substances.

3. Nature of points and round bodies in receiving and parting with electricity—proved by sparks—by mills made to move by the electrical effluvium issuing from a point—by an electric orrery—by the feather experiment—by the wires for preventing damage by lightning—and by experiments made on pointed and round-ended Conductors.

4. Electrical attraction and repulsion proved by Dr. *Franklin's* golden-fish—by the shower of bran, small seeds, &c.—by ringing of bells—and experiments made with the electrometer; electrophor, &c.

5. Theory of negative and positive electricity—proved to be agreeable to the *Franklinean* hypothesis by the electrical flash—by the electrical circuit, and the electrical shock.

LECTURE VIII. *Electricity.*

NATURE and cause of lightening, thunder, earthquakes, aurora borealis, luminous appearance of the sea, &c. Why steeples and houses are liable to be struck with lightening, and how prevented—the safest situations in a storm of lightening pointed out—and why its mischief seems so whimsical and partial. Each of these heads explained by vials, batteries, artificial clouds, showers, &c. 1st, The figure of a man in the electrical circuit is struck down, whilst his wife (out of the circuit) stands close by his side unhurt. 2d, The danger of breaks in a conductor shewn, by stones struck out of a wall, and the demolition of a tall pyramid. 3d, The danger of combustibles being in the way of lightening, by the blowing up of a house, the firing of spirits, cotton, wool, inflammable air, gunpowder, &c. 4th, Positive and negative Electricity shewn by Lord *Mahon* and Mr. *Canton's* experiments—how superinduced, disturbed, &c. 5th, A positive and negative cloud meet in the room, and produce tremendous thunder and lightening—piercing books, breaking glasses, &c. 6th, How Electricity is applied medically, viz. by shocks, sparks, effluvia, &c. 7th, Its light exhibited as a Name, as a diamond necklace, as an aurora in vacuo, &c. &c. A beautiful fortification blown up by Electricity.

LECTURE IX. *Optics.*

1. **V**ARIOUS insects, seeds, farina, pores in roots and branches of plants, animalculæ in various fluids, circulation of the blood, effervescences, discharging fixed air, shooting of salts, &c. exhibited in a curious solar microscope.

2. Light, what it is, and how affected by passing in and out of different mediums, proved by various experiments on a ray of light with air, water, glass, lenses, prisms &c. shewing how light is the occasion of vision, how and why it is condensed in burning glasses and dilated by concave lenses; why convex lenses magnify objects, and concave diminish them; why the picture of objects on the retina of the eye are inverted, and why seen upright; why the prism exhibits various colours; reason of colours in general, the rainbow, blue sky, colours in bubbles, &c.

3. Theory of the reflection of light, and the angles of incidence and reflection, proved by experiments on plane, convex, concave, and cylindrical mirrors; shewing why the image in a plane mirror is twice the distance of the object; why the whole person can be seen in a glass but half its length; why concave mirrors enlarge, and convex diminish objects; distortion, anamorphosis, &c. explained, by paintings seen in concave and convex cylindrical mirrors.—Metals melted in the focus of the largest metal mirror ever yet made.

4. Description and dissection of the reflecting, refracting, and patent telescopes; solar, double, single, and field microscopes; opera glasses, diagonal mirrors, magic-lanterns, camera obscuræ, scyoptick balls, &c.

5. Description and dissection of the eye, the uses of all its parts, and the whole doctrine of vision explained, by several artificial as well as natural eyes; how that noble organ is best preserved, and assisted in short-sighted young and old people.

LECTURE X. *Astronomy.*

1. **T**RUE figure of the earth proved by observation and mensuration; and illustrated by globes, planetariums, orreries, &c.

2. How the different Seasons are produced: day and night; and short days; heat of Summer, and cold of Winter.

3. Antipodes illustrated by globe, drawings, and the terella.

4. Why we perceive not the earth's motion; and how the most ignorant may be convinced even by ocular demonstration, that it is the earth and not the sun that turns round every twenty-four hours, and also how the earth turns round the sun in twelve months.

5. How little the highest mountains affect the round figure of the earth, and why the sea appears flat even to a spectator on the highest eminence.

6. How and why astronomers distinguish the surface of the earth and heavens by lines and circles, viz. meridians, latitudes, horizon, equator, tropics, ecliptic, signs, constellations, declinations, &c.

LECTURE XI. *Astronomy.*

1. **G**ENERAL theory of the moon.

2. Its phasis explained on the orrery, viz. why it appears horned, gibbous, and full.

3. Solar and lunar eclipses, what—how occasioned—why so seldom—and how calculated.

4. Why

4. Why the moon appears so much larger at her rising than on the meridian;—why she rises in the harvest full every evening near the same time for a week together;—why she shines for a fortnight together without setting, every lunation, on the frigid zones.

5. How the earth and moon affect each other, and turn round the common centre of gravity; how tides are occasioned; the currents of the gulph of *Florida*, *Gibraltar*, &c. the small tides of the *West-Indies*; rapid and high tides of the *Thames* and *Severn*; the equinoctial tides, and the tides of the air.

6. Presumption that the moon is a world; dissertation on her motion, seas, continents, mountains, and how the earth must appear to her inhabitants.

LECTURE XII. *Astronomy.*

1. *Ptolemaic*, *Tychonic*, and *Copernican* systems, what.

2. Planetary motion by *Descartes'* vortices exploded.

3. *Newtonian* doctrine of centrifugal and centripetal motions explained by curious experiments on the whirling tables, and applied to the explanation of planetary motion;—*Keplar's* problem—and the correspondence of areas and times solved by them.

4. Dissertation on, and probable cause of the flood—deduced from the shells and fish bones found on mountains—from the arrangement of mountains—the breaks in mines—the dipping strata of the earth, &c.

5. On the grand orrery, and transparent ditto, will be a description of each planet in the solar system, its motions, appearances, and moons; in the course of which will be given a familiar doctrine of parallax—how the distance of the heavenly bodies are found—what advantages the world may derive from observations on the late transit of *Venus*;—what is meant by the equation of time;—precession of the equinoxes; the longitude found by *Jupiter's* satellites;—the retrograde motion of the planets, &c.

6. Dissertation on comets, and the universe of systems.

7. Recapitulation of the whole.

N. B. *An Epitome of Lectures, to assist the memory, sold in the room, price 1s.*—*Also a cure for smoaking chimneys.*

 *Noblemen, or others, may have this course read at their own houses, (if at a proper distance from the apparatus) on easy terms.*—*Use of the globes, taught, &c.*

THE END.

